INSTALLATION MANUAL OF TML BTM BOLT STRAIN GAUGES

BTM Bolt Strain Gauges

In case that strain gauges can not be bonded on the shaft surface of a bolt, the BTM gauge is embedded into a hole drilled at the center of bolt head with A-2 adhesive to measure the axial strain of the bolt on tightening. By calibrating the gauge embedded into the bolt, you can find accurate tightening axial force of the bolt.

1 Specifications

Type	Gauge (mm)		Base (mm)		Gauge Center		Resistance (Ω)	Hole Dia. (mm)
	Length	Width	Length	Width	a	b		
BTM−1C	1	0.7	5.6	1.4	1.8	3.8	120	φ1.6
BTM−6C	6	1.0	12.0	1.7	5	7	120	φ2.0

Gauge lead : Polyurethane covered copper wire φ0.14 80mm long

Applicable bolt : Sectional area loss of bolt due to drilling should be within 5%.

Operating temperature : -10～+80℃

Strain limit : 5000×10^{-6}

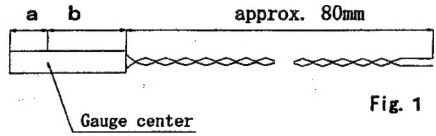

Fig. 1

2 Drilling Bolt

① Hole diameter BTM-1C φ1.6mm BTM-6C φ2.0mm

② Depth When the gauge is embedded, A clearance between the end of the gauge and the bottom of hole should be 3～5mm.

Ex. : In case the gauge center is 30mm from the top of the bolt head,

BTM-1C a⇒1.8mm 30+1.8+3～5=34.8～36.8mm

BTM-6C a⇒ 5mm 30+5 +3～5=38～40mm

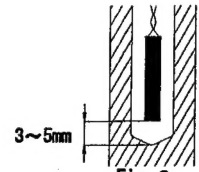

Fig. 2

3 Cleaning of Inner Hole

① Cleaning with solvent(Acetone, etc.)
Wash out drilling oil and dust with solvent through a syringe.

② Wiping off
Remove the remainder thoroughly by a solvent-dampened tissue which is rolled on a drill bit. Repeat till the tissue is not contaminated.

③ Removal of solvent
Remove the remaining solvent in the inner hole with a clean tissue, etc.

* If drilling oil, dust and solvent remain in the hole, curing failure of adhesive may occur.
* Also clean the outside of the bolt such as head and axle.
* Immediately after washing, embed the gauge to avoid contamination by a film of oxide and soil.

4 Embedment Position (Depth)

① Embedment should be made at a position where variation in the section is less.
Embedment into the thread portion, bolt head or the bottom of a hole is badly influenced by the form of the section.

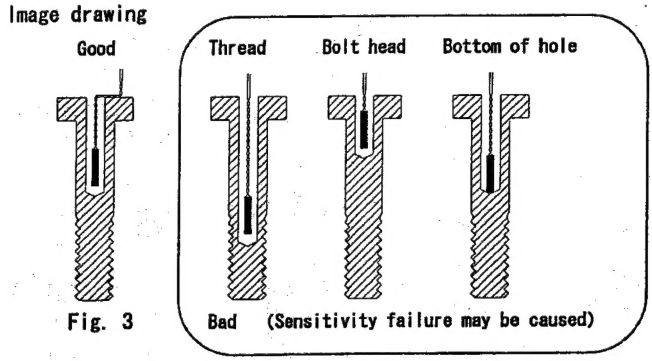

Fig. 3

② Determine an embedment position precisely and measure the embedment length.
③ Mark the gauge leads according to the length.
④ Bend the gauge leads rectangularly at the mark without injuring the insulation material.

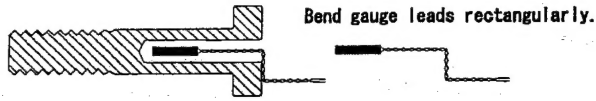

Fig. 4

5 Mixing Adhesive

① Mixing ratio Drug A : Drug B = 10:1 by weight. Use the proper amount.
② Mixing
Mix well.
③ Heating
Warm the mixed adhesive by heat gun, etc. to remove air-bubbles and reduce the viscosity.
The mixed adhesive can be used for 2 - 3 hours.

* For detail, refer to the installation manual of the A-2 adhesive.

6 Preliminary heating

Heat the adhesive and bolt at 50 ~ 60°C for 30 minutes.
Adhesive : Keep fluid by reducing the viscosity. Removing bubble when mixing.
Bolt : Keep the same temperature as the adhesive to maintain the fluidity of the adhesive.

Continues overleaf

7 Pouring of Mixed Adhesive

① With use of syringe

- Enter the mixed adhesive into the syringe.
- Insert the syringe to reach the bottom of the drilled hole.
- Apply the mixed adhesive into the hole from the bottom fully.
  Take care not to produce air bubbles in the hole by adjusting the pulling-up speed of the syringe and pouring speed. When drawing up the syringe from the adhesive, take care not to make air bubbles remain in the hole.
  * A specific needle of 1.8mm dia. is available for embedding BTM-6C, not for BTM-1C.

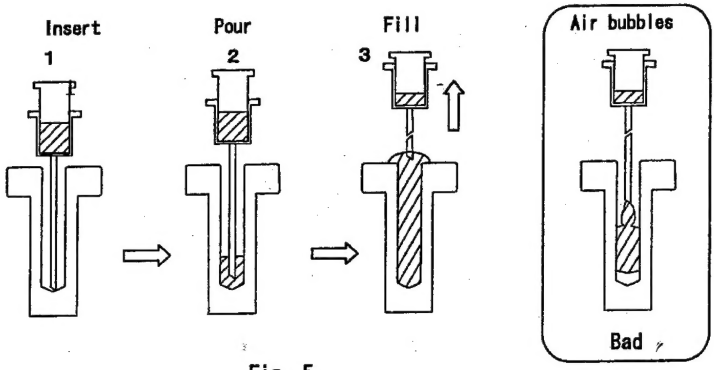

Fig. 5

② With use of vacuum pump

- Make a fence using vinyl tape around bolt head for adhesive pond.
- Pour the mixed adhesive. (For example, proper quantity should be 4 to 5 grams for a drilled hole of 2.0mm in diameter and 50mm in depth.)
- Put bolt into desiccator and create a vacuum for 15 to 20 minutes to get a level at 1 to 10Pa. The time to create vacuum depends upon desiccator volume and pump but vacuum work must be completed within 30 minutes in respect of pot life.
- After completion, remove the fence, and take off an excess adhesive.

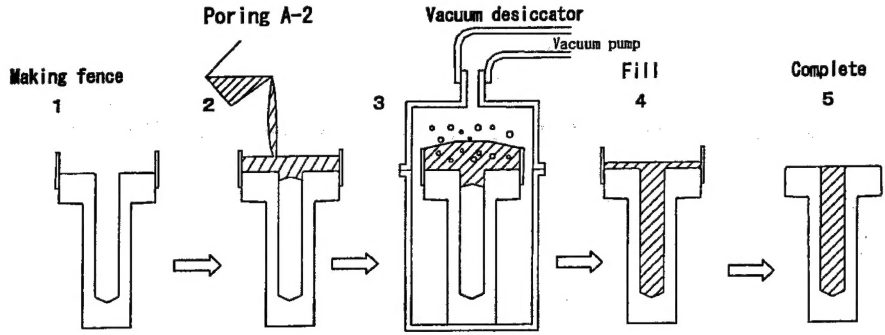

Fig. 6

8 Inserting Gauge

① Apply the mixed adhesive to the bolt gauge.
② Insert the gauge into the hole to put the bent part of gauge leads on the bolt head.
- The gauge should be placed at the center of hole. Take care not to bend or place the gauge eccentrically or at the bottom.
- When inserting the gauge, take care not to develop air bubbles.

③ Allow the adhesive to cure for 12 hours at room temperature. (In this state, the adhesive does not harden.)

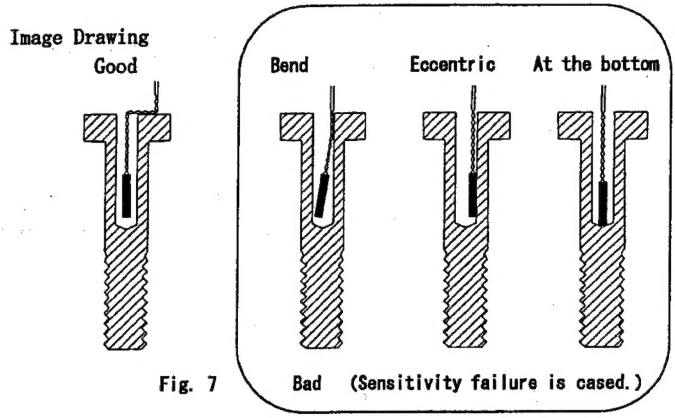

Fig. 7

9 Hot Curing

Cure with the bolt standing in electric furnace for 3 hours at 140°C.
Temperature should be raised after placing the bolt in the furnace.

* **Quick temperature elevation should be avoided; otherwise air bubbles or crack will occur.**

10 Connection

After cooling the bolt, wire the gauge to instrument for measurement.

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